NEGATIVE POLARIZATION OF LIGHT SCATTERED BY CLOSELY PACKED DISPERSE MEDIA ***V. P. Tishkovets***, Kharkiv Astronomical observatory, Sumska 35, Kharkiv,310022, Ukraine.

The linear polarization of light scattered by atmosphereless celestial bodies is characterized by formula $P = (I_{\perp} - I_{\|})/(I_{\perp} + I_{\|})$, where $I_{\perp}$ and $I_{\|}$ are the intensity of perpendicular and parallel components of scattered light with respect to the scattering plane. For many atmosphereless bodies of solar system the polarization at small phase angles is negative. The phenomena of negative polarization of light (NPL) was intensively studied during last years both theoretically and experimentally (see review [1]). In particular, the mechanism based on the effect of weak localization of photons has been studied in detail in [2].

NPL can also arise at scattering by randomly oriented multispheres [3], which is explained by another mechanism. This mechanism is effective for closely packed disperse absorbing powders, containing a considerable part of scatterers with sizes of about wavelength λ. To explain the mechanism we consider the electromagnetic field in the vicinity of an isolated spherical particle of a radius a. Because of different speeds of waves outside and inside the particle, the surfaces of constant phases of the waves near the particle have a crater-like shape. Fig. 1 shows the section of these surfaces by the xz-plane. The incident wave is propagated along z-axis and is polarized along x-axis. As one can see, the distance from the surface of the particle to the zone of imperturbed wave is $\sim\lambda$. It is characteristic for other sizes and refractive indexes of particles. In the zone of perturbed wave the strength vector of field contains a component directed along z-axis (in plane $x = 0$ it is equal to zero). This component is parallel to any scattering planes. Therefore, the light scattered by the other particles localized within the disturbed areas of wave decreases resulting polarization P for such system of particles at all phase angles α. The conditions under which NPL arises are realized even after orientation averaging on the particle system.

In Fig. 2 and Fig. 3 the examples of numerical calculations for randomly orientated clusters of identical spherical particles are given. The size parameters of particles are $k = 4$ ($k = 2\pi/\lambda$) and the refractive index is $m = 1.32 + 0.05\,i$. Only single and double scattered light components were taken into account. Fig. 2 corresponds to the biosphere when the distance between components is $kd = 10$, Fig. 3 corresponds to the triplet with touching components. The dot-dashed lines present the polarization of light due to the effect of weak localization [2] and the solid lines correspond to the proposed mechanism. The solid lines practically coincide with the exact results [3]. The dashed lines characterize the polarization for an isolated particle. Polarization increases when the distance d between components of clusters increases. If $kd > 11$ the polarization is described by the mechanism given in [2].

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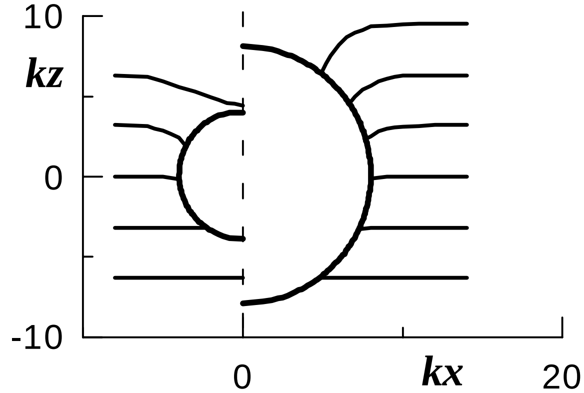

Fig. 1. Lines of constant phases of total field near particles. $m = 1.32 + 0.05\,i$ and $ka = 4$ for the left part, $m = 1.5 + 0.05\,i$ and $ka = 8$ for the right part.

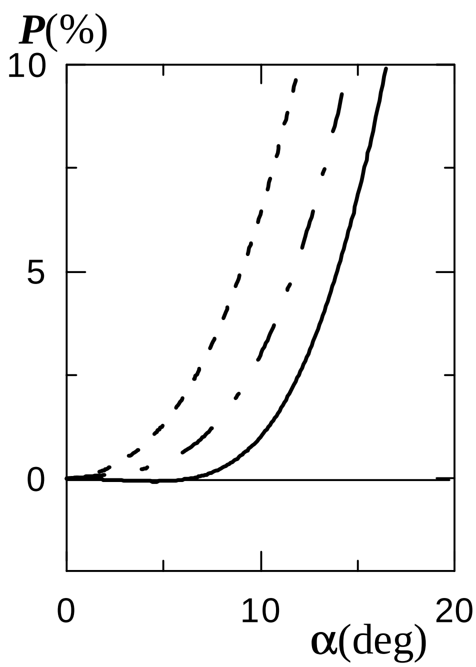

Fig. 2.

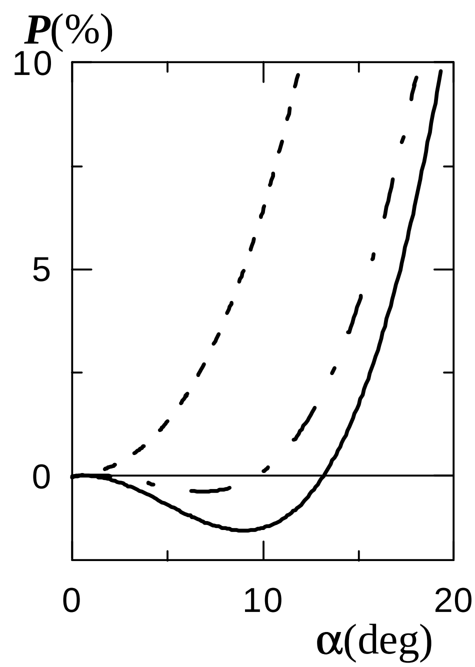

Fig. 3.

References:

[1] Yu. G.Shkuratov et. al., Earth, Moon and Planets, **65**, 201-246, 1994

[2] Yu. G.Shkuratov, Astronomic. Vestnik, **25**, 152-161, 1989.

[3] V. P. Tishkovets, Kinem. Fis. Nebes. Tel, **10**(2), 58-63, 1994.